WEATHER ABNORMALITIES IN THE UNITED STATES (8TH NOTE)—HIGH TEMPERATURE IN JULY, 1930

By ALFRED J. HENRY

The daily maximum temperature in Washington, D. C., in July, 1930, passed the 90° mark on 18 days and the 100° mark on 6 days, 4 of which were consecutive. The maximum of the month, 106° on the 20th, was also the absolute maximum during the period of observations that began in 1870. The 4-day period of maximum temperature of 100° or more is also a second high point in the last 60 years of observation. These extraordinary temperatures were not peculiar to the eastern seaboard but prevailed also over a very considerable part of the country from the eastern foothills of the Rocky Mountains to the eastern seaboard States of Maryland and Virginia and from North Dakota to northern Louisiana. Also in California and Arizona although high temperatures locally in these States are more or less common in the hot season, especially in the Great Valley of California and in the lower Colorado Valley in Arizona and California.

It might be inferred that unusual atmospheric conditions must have been experienced in order to cause such high temperatures; on the contrary the novice in reading the daily weather charts doubtless would be more or less puzzled to account for the high temperatures that prevailed over so great an area.

There are at least three great factors in the heating of the atmosphere, viz, (1) the amount of solar radiation; (2) the horizontal transfer of heat from place to place, and (3) the amount and character of terrestrial radiation.

Thanks to Abbot and his colleagues the amount of solar radiation received day by day is pretty well known but we can not, as yet, pass directly from measures of the daily output of the sun to the corresponding terrestrial temperatures. The second factor—the horizontal transfer of heat by the wind and by ocean currents—seems to be the chief agency by which daily changes in temperature are brought about. Little is known, quantitatively, of the amount of cooling that may be due to radiation from both the earth and its atmosphere.

The solar constant values as cabled from Montezuma, Chili, to the Astrophysical Observatory of the Smithsonian Institution and published on the Weather Bureau daily weather chart for July were higher than the average, but as above indicated no one has been able to satisfactorily correlate solar constant measures and terrestrial temperatures; it may be said, however, that studies of a sequence of daily constant measures and temperatures at Washington, D. C., by Dr. C. G. Abbot show some correlation between high solar constant values and high temperature at Washington.

The second factor, viz, the horizontal transfer of heat from one point to another, finds its fullest application in the cold season when the air currents bring tropical air from the south and conversely when northerly currents bring polar air into lower latitudes. It is therefore through the agency of cyclones and anticyclones that periods of pronounced heat and cold are brought about. In summer, however, while cyclones are associated with higher temperatures around their eastern and southern fronts, it may be questioned whether that increase in temperature is directly due to the presence of the cyclone. An alternative view is that due to the cumulative effect of solar radiation from clear skies in areas remote from the sea, minus the loss of heat by nocturnal radiation, a heat balance is accumulated that is favorable to high maxima; for example, a cloud blanket at night may so diminish nocturnal radiation that the morning temperature may be several degrees higher than it was on the previous morning and as a result the maximum is higher by that amount than on the previous day, with practically the same amount of solar radiation.

An examination of the days during July, 1930, when maximum temperatures as reported telegraphically from the 200 and more weather stations in the United States and Canada reached and passed 100° clearly shows a high degree of correlation between the current high temperatures and the geographic center of the barometric depression.

It is not known for a certainty whether the high temperature is the cause of the low pressure or vice versa.

One of the relations between the temperature and the immediate proximity of a cyclonic wind system about which there is no shadow of doubt is that when the sequence is cyclone-anticyclone-cyclone the higher temperature of the cyclone gives way to the lower temperature of the anticyclone; but when the sequence is cyclone-cyclone-cyclone without the intervention of an anticyclone the result is high temperature for the season, the degree of warmth being conditioned upon the time that such a sequence prevails.

This in short is the explanation of the visible mechanism whereby exceptionally high temperatures were prevalent in various parts of the United States in July 1930. The heated spell as a whole may be referred to the passage of at least eight ill-defined low pressure areas along the Canadian border or a little north of it.

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The foregoing was prepared for the July issue of this REVIEW. While the temperature on the 1st of August was slightly below the normal a second heated spell, or perhaps a continuation of the first set in on August 2 culminating in a maximum at Washington, D. C., of 102° on the 4th and 5th and again on the 9th. There were 5 out of the first 10 days of August with maximum temperatures of 100 or over and 7 days with maxima of 90° or more. The heated spell came to an end on August 10 when the maximum temperature was but 89° and the mean temperature dropped below normal on the 11th and has remained below at the date of this writing (August 18).—*A. J. H.*

The foregoing presents merely the facts of pressure distribution in the United States and Canada during the heated term. Owing to circumstances into which I need not enter at this time the complete data of monthly mean pressure for the world-wide network of meteorological stations in the Northern Hemisphere for several months prior to July of this year are not available and will not appear in printed form until, say 1938 or eight years hence, basing this statement on the fact that the most recent world-wide data are for the year 1922. Neither should it be assumed that if the more recent data were available the answer to the why and the wherefore of the heated term would be immediately forthcoming.

A true scientist does not demean himself or the science he represents by admitting defeat in the solution of some of the problems he encounters. Meterologists have known and studied cyclones and anticyclones for upward of 60 years. Many things are known as to their movement and the relation of that movement to the weather a few days in advance; but just how and why they come into being and follow this course or that course or quickly cease to exist is one of the unsolved problems of the meteorologist. When these pressure formations fail of development in the usual number, or when they lack in the essential characteristics of form, continuity, and speed of travel high temperature and sometimes, but not always, widespread drought occurs; in other words "stagnation" or the breaking down of the secondary circulation is the fundamental fact that furnishes the keynote to the abnormality. Why it should stagnate or break down we do not know. Reeder (this REVIEW 47:711–715) associates droughts and hot weather with the movement of cirrus clouds from the east, or in other words the currents in the cirrus level are reversed for the time being.

NOTES, ABSTRACTS, AND REVIEWS

Beitrag zur Langfrist-Wettervorhersage. By F. B. Groissmayr. Ann. Hydrogr. Berlin, 1928, pp. 287–293, 310–317[1]—The main interest of this pair of papers is the influence of Charleston rainfall on world weather, and I have prepared a note which follows in criticism. The following are some of the coefficients which Professor Groissmayr gets with Charleston rainfall: +0.64 with Charleston rain next year, +0.61 with the Nile two years later; −0.66 with Azores-Iceland pressure December to February two and one-half years later, in each case based on about 50 years of data. He also connects the autumn temperature of the Eastern United States with Argentine pressure in May preceding.

Note on Charleston rainfall and its relation to world weather.—In view of the surprisingly large coefficients obtained by Professor Groissmayr with a single rain gage at Charleston it seemed advisable to try whether the results would be equally shown by the rainfall indicated by the rain gages of the neighborhood. From the Summaries of Climatological Data by Sections [2] I selected a number of such stations and correlated their rainfall with the Nile two years later as follows: Hatteras 0.42, Pinopolis 0.24, Savannah 0.36, Wilmington 0.40; further, the mean of the seven stations—Jacksonville, Savannah, Augusta, Southport, Wilmington, Charlotte, and Pinopolis gave the coefficient 0.42 with 50 years of data. It may be concluded, therefore, that the relationship 0.60 with Charleston is fictitiously big.

Another test may be applied by extending the data still further back and a graphical comparison of the period 1834–1870 does not show a particularly close relationship.

It is also of interest to correlate with the Nile at intervals other than that of two years chosen by Professor Groissmayr. With Carolina rainfall and the Nile of the same year the coefficient is 0.20, with the Nile one year later 0.34, two years later 0.42, three years later 0.42, and four years later 0.28, so that there is a good deal of persistence probably due to slow changes common to both factors.

The above tests were made at the suggestion of Sir Gilbert Walker.

E. W. Bliss.

Maximum precipitation in short periods of time,[3] *by Charles D. Reed (Author's Abstract)*.—Records of the greatest precipitation in short periods of time are obtained by the United States Weather Bureau with automatic recording rain gages for the purpose of assisting architects in planning the drainage of flat roofs and engineers in designing sewers and other drainage.

The greatest rainfall in five minutes known to the Weather Bureau, in Iowa, is 0.80 inch at Dubuque. Dubuque also holds the record for the greatest amount in 30 minutes and 2 hours, while Sioux City holds the record for 10 minutes, 15 minutes, and 1 hour. Records for seven stations are available. The most frequent intensity at Des Moines for a 5-minute period is between 0.30 and 0.40 inch. There are 14 years with such maxima out of 33. As the intensity of rainfall decreases the frequency increases.

Meteorological Observations of the First Shackleton (Nimrod) Expedition, by Dr. Edward Kidson.—The first Shackleton Expedition, 1907–1909, established its base at Cape Royds on the west side of Ross Island. The geographic coordinates of the position are approximately latitude 77° 34′ S., longitude 166° 9′ E. This position will be recognized as the gateway used by the British and also by Amundsen through which access to the South Pole was sought. For one reason or another the meteorological observations made by this expedition were not promptly printed. On the initiative of the Australian National Research Council, the Commonwealth Meteorologist, and others, steps were taken to print the observations; accordingly, a small committee was formed, which in conjunction with Doctor Kidson prepared the volume under review.

Antarctica continues to be the goal of geographic exploration, notwithstanding the large amount of information thereon that has been accumulated since the beginning of the twentieth century.

The return of the American expedition of Admiral Byrd, as this note is being written, lends additional interest to the subject. The Ross Sea area in which the meteorological observations included in the work under review were made, is best known by the very comprehensive treatment of its meteorology by Dr. George C. Simpson, the meteorologist of the last Scott Expedition and now Director of the British Meteorological Service.[4]

In closing, I can do no better than to quote Doctor Kidson's remarks on page 120 of the work.[5]

> *General*.—There is no portion of the earth comparable with the Antarctic in size of which our knowledge of the meteorolgy is so inadequate. Yet the interest attached to its weather processes is in many ways unique. Not only is it at one of the poles of the earth, but it is at the pole of that hemisphere in which meteorological conditions are the simpler and which offers, perhaps, the best field for the study of the general circulation. It is obvious that we can get no complete picture of world meteorology so long as such a gap remains, and the conclusion is rapidly being forced upon meteorologists in all quarters of the globe that their local weather is a function of world conditions. From the few and scattered records available it is already clear that the differences between seasons are accentuated in the Antarctic. Consequently, if a long series of records from a few well-distributed stations were available much might be learned regarding the nature and causes of seasonal variations in the world generally. It is very much to be hoped that the scientific problems of the region will soon again be attacked by properly organized bodies with resources adequate for the purpose. And when this is done, one of the most important aims should be the establishment of permanent meteorolgical stations.

[1] Reprinted from Meteorological Magazine, London, April, 1930.
[2] Washington. Bulletin W., 2d edition, 1926.
[3] Read before Iowa Academy of Science, May 2, 1930.
[4] British Antarctic Expedition, 1910–1913. Meteorology, vol. 1, discussion by G. C. Simpson, D. Sc. F. R. S., Calcutta, 1919.
[5] British Antarctic Expedition, 1907–1909. Reports on the scientific investigations Meteorology, by Edward Kidson, D. Sc., Melbourne, 1930, p. 120.